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Economic, Environmental, and Benefits Analysis of the Proposed Metal Products and Machinery Rule

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Executive Summary

Introduction

EPA is proposing effluent limitations guidelines and standards for the Metal Products and Machinery (MP&M) industry. This document presents EPA's economic and environmental analyses supporting the proposed rule. The Executive Summary provides an overview of the costs and benefits of the regulation.

Overall, EPA finds that the proposed rule provides significant benefits that are likely to outweigh the social costs of the rule. Moreover, the rule has modest economic impacts. The Agency is continuing to develop and refine its methodologies for estimating the benefits of improved water quality resulting from effluent guidelines, and has used new approaches in some cases in the benefits analyses presented in these reports. EPA recognizes that estimates of both costs and benefits are uncertain, and therefore conducted a number of checks on the reasonableness of the analysis results. In particular, EPA undertook the Ohio case study to perform more detailed and complete benefits analyses than were feasible for the nation as a whole. The Agency is seeking comment on the methodologies and results of both the national analyses and the Ohio case study. Additional information on issues associated with extrapolation of the benefit results can be found in Section E.4.

Detailed descriptions of the analytic methodologies and results are presented in the Economic, Environmental, and Benefit Assessment (EEBA). In addition, the EEBA presents costs, benefits, and economic impacts for alternatives to the proposed rule that were considered by EPA.

ES.1 Overview of the MP&M Industry and its Effluent Discharges

The proposed regulation will apply to process wastewater discharges from MP&M facilities performing manufacturing, rebuilding, or maintenance on a metal part, product, or machine using an MP&M operation and discharging process wastewater either directly or indirectly to surface waters. These potentially-regulated MP&M facilities represent only a portion of all facilities in the relevant industrial sectors, since some facilities do not generate or discharge process wastewater.

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Department of Commerce data indicate that there are more than 1.3 million establishments operating in potential MP&M sectors. The MP&M survey results indicate that there are approximately 89,000 MP&M facilities that manufacture, rebuild, or repair metal machines, parts, products, or equipment using processes covered by the proposed rule. Of these 89,000, approximately 26,000 do not use or discharge water or use a contract hauler for their wastewater. Only 62,752 facilities, or 71 percent of the MP&M facilities, are water-discharging facilities that could be potentially subject to the MP&M regulation. These 62,752 water-discharging facilities include 57,948 indirect dischargers (i.e., facilities discharging effluent to a publicly-owned sewage treatment works or POTWs) and 4,804 direct dischargers (i.e., facilities discharging effluent directly to a waterway under a NPDES permit).

Table ES.1 shows the estimated number of MP&M facilities (water dischargers and zero dischargers) and total discharge flow (prior to implementation of the proposed rule) by type of facility. The largest number of sites, approximately 44,000, perform "rebuilding/maintenance only" and account

for approximately 9 percent of the total estimated discharge flow for the industry. "Manufacturing only" represents the next largest number of facilities (27,000) and represents the largest percentage of the total estimated discharge flow for the industry (75 percent).

Table ES.1: Number of MP&M Facilities (Water-Discharging and Zero-Discharge) and Total Discharge Flow by Type of Facility

Type of Facility	Number of Facilities	Total Estimated Discharge Flow (million gal.yr)	Percent of Facilities	Percent of Total Discharge Flow
Manufacturing & Rebuilding/Maintenance	7,400	11,200	8.3%	9.1%
Manufacturing Only	27,000	91,700	30.4%	75.2%
Rebuilding/Maintenance Only	44,000	11,100	49.5%	9.1%
Unknown/others	10,500	8,100	11.8%	6.6%
Total	89,000	122,000	100.0%	100.0%

Source: U.S. EPA analysis. See Technical Development Document *for the proposed rule.*

Table ES.2 compares the number of potentially-regulated facilities with the number that are actually subject to requirements under the proposed rule. Of the 62,752 water discharging facilities, 3,766 are predicted to close in the baseline, leaving 58,986 facilities operating in the baseline that EPA estimates could be regulated. The proposed rule would regulate 9,839 of these facilities, including 5,186 indirect discharging facilities and 4,653 direct dischargers.

The estimated 9,839 water-discharging facilities that are regulated under the preferred option represent less than 0.8 percent of all facilities in the MP&M industries, and 17 percent of those that are potentially regulated. Over 90 percent of the potentially-regulated indirect dischargers will not be subject to requirements under the proposed rule, whereas the proposed rule will regulate all of the direct dischargers operating in the baseline.

Table ES.2: Number of MP&M Facilities Potentially-Regulated and Subject to Requirements under the Proposed Rule

	All Water-Discharging MP&M Facilities	Operating in the Baseline	Regulated under the Proposed Rule	Percent of Facilities Operating in the Baseline that are Regulated
Direct	4,804	4,653	4,653	100%
Indirect	57,948	54,333	5,186	10%
Total	62,752	58,986	9,839	17%

Source: U.S. EPA analysis.

The following are important characteristics of the MP&M industries as a whole and of the portion of those industries potentially-regulated under the proposed rule.

Many potentially-regulated MP&M facilities produce goods and services that serve multiple market sectors. It is not possible to associate regulatory costs and benefits to particular sectors, because EPA is not able to link regulated processes to specific sectors for facilities operating in

multiple sectors. The results of EPA's cost and economic impact analyses are disaggregated by type of facility but not by sector.

Establishments in the relevant MP&M industries are located in every state, with a particular concentration in the heavy industrial regions along the Gulf Coast, both East and West Coasts and the Great Lakes Region. Moreover, MP&M facilities are frequently located in highly populated regions. Based on survey information, 24% of facilities receiving detailed MP&M questionnaires are located in counties with populations of at least 1 million people, and 42% of facilities sampled are located in counties with populations of at least 500 thousand people.[1]

EPA is regulating the MP&M industry because the industry releases substantial quantities of pollutants, including toxic pollutant compounds (priority and nonconventional metals and organics) and conventional pollutants such as total suspended solids (TSS) and oil and grease (O&G). These MP&M industry pollutants are generally controlled by straightforward and widely-used treatment system technologies such as chemical precipitation and clarification (frequently referred to as the lime and settle process).

Discharges of these pollutants to surface waters and POTWs have a number of adverse effects, including degradation of aquatic habitats, reduced survivability and diversity of native aquatic life, and increased human health risk through the consumption of contaminated fish and water. In addition, many of these pollutants volatilize into the air, disrupt biological wastewater treatment systems, and contaminate sewage sludge.

ES.2 Description of the Proposed Rule

EPA grouped facilities into subcategories as a basis for the proposed regulation. The subcategories differ in part based on the type of wastewater that facilities discharge, including:

- facilities that discharge wastewaters with high metals content, with or without oil and grease (O&G); and
- facilities that discharge wastewaters containing mainly O&G, with limited metals and associated other organic constituents.

The subcategories identified by EPA in each group are:

Metal-bearing (with or without O&G):

- Non Chromium Anodizing: facilities that perform aluminum anodizing without the use of chromic acid or dichromate sealants;
- Metal Finishing Job Shops: facilities that perform one or more of six metal finishing operations and that own no more than 50 percent of the materials undergoing metal finishing;
- Printed Wiring Board: facilities manufacture, maintain, and repair printed wiring boards (i.e., circuit boards), not including job shops;
- Steel Forming & Finishing: facilities that perform MP&M operations or cold forming operations on steel wire, rod, bar, pipe, or tube;
- General Metals: MP&M facilities that discharge metal-bearing wastewater, with or without oil-bearing wastewater, that do not fit into one of the other metal-bearing subcategories described above.

Oil-bearing only:

- Shipbuilding Dry Docks: MP&M process wastewater generated in or around dry docks and similar structures, such as graving docks, building ways, marine railways, and lift barges at shipbuilding facilities. These structures include sumps or containment systems that enable shipyards to control the discharge of pollutants to the surface water.
- Railroad Line Maintenance: facilities that perform routine cleaning and light maintenance on railroad engines, cars, car-wheel trucks, and similar parts or machines, and discharge only from oily operations and/or washing of the final product.
- Oily Wastes: MP&M facilities that discharge only oil-bearing wastewater from a specified list of unit operations and that are not Shipbuilding Dry Dock or Railroad Line Maintenance facilities.

EPA evaluated ten technology options that might be used to treat wastewaters from the MP&M facilities. Table ES.3 lists these technology options:

[1] EPA is not able to characterize the location characteristics of all potentially-regulated MP&M facilities at the national level precisely, because the MP&M survey design was not intended to provide national results by location characteristics.

Table ES.3: Technology Options

Option #	Description
For metal-bearing wastes	
1	segregation of wastewaters, preliminary treatment (including oil-water separation), chemical precipitation, and sedimentation using a clarifier (chemical precipitation with gravity clarification)
2	in-process flow control and pollution prevention + option 1
3	segregation of wastewaters, preliminary treatment (including oil removal by ultrafiltration), chemical precipitation, and solids separation using a microfilter
4	in-process flow control and pollution prevention + option 3
For oil-bearing wastes	
5	oil-water separation by chemical emulsion breaking
6	in-process flow control and pollution prevention + option 5
7	oil-water separation by ultrafiltration
8	in-process flow control and pollution prevention + option 7
9	oil-water separation by dissolved air flotation (DAF)
10	in-process flow control and pollution prevention + option 9

EPA defined specific effluent limitations based on a statistical analysis of the performance of these technologies. The even-numbered options add in-process flow controls and pollution prevention (i.e., pollution prevention, recycling, and water conservation to allow recovery and reuse of materials) to the treatment technologies specified in the odd-numbered options. In all cases, options with in-process flow control and pollution prevention cost less and remove more pollutants than do the comparable options without pollution prevention. The EEBA, therefore, did not analyze options without flow control and pollution prevention.

The Agency considered a range of low flow exclusions for indirect dischargers, to reduce burdens on permitting officials and reduce the economic impacts of the rule.

Evaluation of the low flow cutoffs considered the amount of pollutant discharged by each subcategory and flow size category.

Table ES.4 shows the technology options and exclusions that EPA is proposing for each subcategory. This table also defines two regulatory alternatives for which EPA evaluated costs, benefits, economic impacts and cost-effectiveness. These include:

- Option 2/6/10, which applies the same technologies for each subcategory, and eliminates the low flow and subcategory exclusions of the proposed rule, and
- Option 4/8, which applies more stringent technology requirements for all subcategories and does not include low flow exclusions.

Table ES.4: Summary of Proposed Rule and Regulatory Alternatives for Existing Sources

Subcategory	Proposed rule	Option 2/6/10	Option 4/8
General Metals	Technology option 2; 1 mgy flow cutoff for indirect dischargers	Technology option 2	Technology option 4
Metal Finishing Job Shop	Technology option 2	Technology option 2	Technology option 4
Non-Chromium Anodizing	Technology option 2; no PSES for indirect dischargers	Technology option 2	Technology option 4
Oily Wastes	Technology option 6; 2 mgy flow cutoff for indirect dischargers	Technology option 6	Technology option 8
Printed Wiring Board	Technology option 2	Technology option 2	Technology option 4
Railroad Line Maintenance	Technology option 10; no PSES for indirect dischargers	Technology option 10	Technology option 8
Shipbuilding Dry Dock	Technology option 10; no PSES for indirect dischargers	Technology option 10	Technology option 8
Steel Forming & Finishing	Technology option 2	Technology option 2	Technology option 4

Note: PSES = Pretreatment Standards for Existing Sources. The standards for different classes of dischargers are discussed in Chapter 4 of the EEBA.

ES.3 Economic Impacts and Social Costs of the Proposed Rule

EPA assessed the economic impacts and social costs associated with the proposed rule using detailed financial and technical data from a series of surveys of MP&M facilities. Engineering analyses of these facilities identified the pollution prevention and treatment systems needed to comply with the proposed rule and other regulatory alternatives. The estimated capital and annual operating and maintenance costs of these systems, incremental to the costs of systems already in place, represent the compliance costs of the rule.[2] EPA analyzed the financial performance of potentially-regulated facilities under the current conditions (the baseline) and subject to the proposed regulatory requirements. The Agency used a variety of measures to assess the economic impacts resulting from the proposed rule, both for the regulated MP&M facilities and for the firms and governments that own the facilities. The economic impact analysis also considered impacts for small entities in particular, and impacts on employment, foreign trade and communities. The results of the analyses for sample facilities were extrapolated using survey sample weights for each facility, to provide national-level results.

[2] The annual equivalent of capital and other one-time costs is calculated by annualizing costs at a seven percent discount rate over an estimated 15 year equipment life. Annual compliance costs are annualized capital costs plus annual operating and maintenance (O&M) costs.

ES.3.1 Economic Impacts

Overall, EPA found the economic impacts of the proposed rule to be very modest. The following are EPA's findings for different categories of impacts.

a. Facility impacts

The facility impact analysis assesses how facilities will be affected financially by the proposed rule. Key outputs of the facility impact analysis include expected facility closures in the MP&M industries, associated losses in employment, and the number of facilities experiencing financial stress short of closure ("moderate impacts"). EPA performed economic impact analyses for three categories of facilities, using different methodologies to evaluate each of the groups. The three groups are:

- Private MP&M Facilities. This group includes privately-owned facilities that do not perform railroad line maintenance and are not owned by governments. This major category includes private businesses in a wide range of sectors or industries, including facilities that manufacture and rebuild railroad equipment. Only facilities that repair railroad track and equipment along the railroad line are not included.
- Railroad line maintenance facilities maintain and repair railroad track, equipment and vehicles.
- Government-owned facilities include MP&M facilities operated by municipalities, State agencies and other public sector entities such as State

universities. Many of these facilities repair, rebuild, and maintain buses, trucks, cars, utility vehicles (e.g., snow plows and street cleaners), and light machinery.

The specific methodology used to assess impacts differed for each of the three types of MP&M facilities. For private MP&M facilities, EPA established thresholds for measures of financial performance and compared the facilities' performance before and after compliance with each regulatory option with these thresholds. Impacts were measured at the operating company level for railroad line maintenance facilities, since firms are unlikely to keep track of financial performance at the facility level for these sites. For governments, EPA compared compliance costs with facilities' baseline costs of service, and assessed the impact of the compliance costs on the government's taxpayers and on its ability to finance compliance costs by issuing debt.

EPA identified facilities that are financially weak and might be expected to close under baseline conditions. Of the estimated 62,752 discharging facilities, 6.1 percent or 3,829 facilities were assessed as baseline closures. The 3,829 baseline closures include 3,678 indirect dischargers, or 6.3 percent of indirect dischargers, and 151 direct dischargers, or 3.1 percent of direct dischargers. These facilities were excluded from the post-compliance analysis of regulatory impacts.

Table ES.5 provides an overview of the facility-level economic impacts for the proposed rule. This table shows that less than one-half of one percent of facilities are projected to close due to the rule, and approximately one percent are expected to experience moderate financial stress short of closure. The proposed rule excludes over 90 percent of the indirect discharging facilities from any requirements.

Table ES.5: Regulatory Impacts for All Facilities, Proposed Rule, National Estimates

	Total	Direct	Indirect
Number of facilities operating in the baseline: total	58,922	4,653	54,270
private MP&M and railroad line maintenance	*54,590*	*3,999*	*50592*
government-owned	*4,332*	*654*	*3678*
Number of regulatory closures	199	20	179
Percent of facilities operating in the baseline that are regulatory closures	0.3%	0.4%	0.3%
Number of facilities operating post-regulation	58,787[a]	4,633	54,154[a]
Number of facilities below low flow cutoffs	48,256[a]		48,256[a]
Number of facilities with subcategory exclusions	955		955
Percent of facilities operating in the baseline excluded or below cutoffs	83.5%		90.6%
Number of facilities operating subject to regulatory requirements	9,576	4,633	4,943
Number of facilities experiencing moderate impacts	616	41	575
Percent of facilities operating in the baseline that experience moderate impacts	1.0%	0.9%	1.1%

a. Includes 64 avoided baseline closures -- general metals indirect dischargers below the low flow cutoffs that are projected to close in the baseline but that remain open under the proposed rule.
Source: U.S. EPA analysis.

Table ES.6 shows the results of the analysis by subcategory and discharge status. The table shows that substantial portions of the General Metals and Oily Waste indirect dischargers are excluded by the low flow cutoffs. Metal Finishing Job Shops account for the largest number of closures among indirect dischargers under the proposed rule, and Printed Wiring Board and Metal Finishing Job Shop facilities together account for the largest portion of moderate impacts. Most of the direct discharger impacts (closures and moderate impacts) are in the General Metals subcategory, although the closures and moderately-impacted facilities represent a small percentage of the General Metals direct discharging facilities as a whole.

Table ES.6: Regulatory Impacts by Subcategory, Proposed Rule, National Estimates

Subcategory	# Facilities Operating in Baseline	Regulatory Closures	% Closures	# Exempted	% Exempted	# with Moderate Impacts	% Moderate Impacts
Indirect Dischargers							
General Metals	23,140	24	0.1%	20,164[a]	87%	153	0.7%
Metal Finishing Job Shop	1,231	128	10.4%			117	9.5%
Non-Chromium Anodizing	150	0	0%	150	100%	0	0%
Printed Wiring Board	620	7	1.1%			301	48.7%
Steel Forming & Finishing	105	6	5.7%			4	3.8%
Oily Waste	28,219	14	<.0.1%	28,092	99.5%	-	-
Railroad Line Maintenance	799	0	0%	799	100%	0	0%
Shipbuilding Dry Dock	6	0	0%	6	100%	0	0%
All Indirect Dischargers	54,270	179	0.3%	49,211[a]	91%	575	1.1%
Direct Dischargers							
General Metals	3,636	20	0.6%			34	0.9%
Metal Finishing Job Shop	12	0	0%			0	0%
Non-Chromium Anodizing	0						
Printed Wiring Board	11	0	0%			0	0%
Steel Forming & Finishing	43	0	0%			7	16.3%
Oily Waste	911	0	0%			0	0%
Railroad Line Maintenance	34	0	0%			0	0%
Shipbuilding Dry Dock	6	0	0%			0	0%
All Direct Dischargers	4,653	20	0.4%			41	0.9%

a. Includes 64 avoided closures -- general metals indirect dischargers that are projected to close in the baseline but which operate under the proposed rule and are eligible for the low flow cutoff.
Note: may not sum to totals due to independent rounding.
Source: U.S. EPA analysis.

Table ES.7 summarizes impacts for government-owned facilities in particular. Under the proposed rule, 83 percent of the government-owned facilities would be excluded from requirements because they fall below the low flow cutoff proposed for indirect dischargers. The compliance costs of the proposed rule do not result in significant budgetary impacts for any of the governments that operate the facilities.

Table ES.7: Regulatory Impacts for Government-Owned Facilities, Proposed Rule, National Estimates	
Number of government-owned facilities operating in the baseline & post-regulation	4,332
Number of facilities below low flow cutoffs	3,603
Percent of facilities operating in the baseline below cutoffs	83.2%
Number of facilities operating subject to regulatory requirements	729
Number of facilities experiencing impacts	0
Percent of facilities operating in the baseline that experience significant budgetary impacts	0%

Source: U.S. EPA analysis.

b. Firm level impacts

EPA examined the impacts of the proposed rule on firms that own MP&M facilities, as well as on the financial condition of the facilities themselves. A firm that owns multiple MP&M facilities could experience adverse financial impacts at the firm level if its facilities are among those that incur significant impacts at the facility level. The firm-level analysis is also used to compare impacts on small versus large firms, as required by the Regulatory Flexibility Act and the Small Business Regulatory Enforcement Fairness Act.

EPA compared compliance costs with revenue at the firm level as a measure of the relative burden of compliance costs. EPA applied this analysis only to MP&M facilities owned by private entities. EPA estimated firm-level compliance costs by summing costs for all facilities owned by the same firm that responded to the survey plus estimated compliance costs for additional facilities for which respondents submitted voluntary information. The Agency was not able to estimate the national numbers of firms that own MP&M facilities precisely, because the sample weights based on the survey design represent numbers of facilities rather than firms. Most MP&M facilities (43,118 of 54,590, or 80 percent) are single-facility firms, however. These firms can be analyzed using the survey weights. In addition, there are 289 firms that own more than one sample facility. These firms are included in the analysis with a sample weight of one, since it is not known how many firms these 289 sample firms represent.

Table ES.8 shows the results of the firm-level analysis. The results represent a total of 43,407 MP&M firms (43,118 + 289), owning 54,590 facilities (43,118 owned by single-facility firms + 11,473 owned by multi-facility firms).

Table ES.8: Firm Level Before-Tax Annual Compliance Costs as a Percent of Annual Revenues						
Number of Firms in the Analysis[a]	**Number and Percent with Before-Tax Annual Compliance Costs/Annual Revenues Equal to:**					
	Less than 1%		**1-3%**		**Over 3%**	
	Number	**%**	**Number**	**%**	**Number**	**%**
43,407	41,236	95%	1,070	2.5%	1,101	2.5%

a. Firms whose only MP&M facilities close in the baseline are excluded.

A small percentage (2.5 percent) of the firms in the analysis incur before-tax compliance costs equal to 3 percent or more of annual revenues. Ninety-five percent incur compliance costs less than 1 percent of annual revenues, and the remaining 2.5 percent incur costs between 1 and 3 percent of revenues. Of 2,171 firms in the analysis that incur costs greater than 1 percent of revenues, 636 are single-facility small firms that were reported in the facility impact analysis to close (161 firms) or experience moderate impacts (475 firms) due to the rule.

This analysis is likely to overstate costs at the firm level for two reasons. First, it includes compliance costs for facilities that are projected to close due to the rule. The estimated

compliance costs for these facilities are higher than the true cost to the firm of shutting down the facility, as illustrated by the detailed facility impact analysis that projects closures. Second, the analysis does not take account of actions a multi-facility firm might take to reduce its compliance costs under the proposed rule. These include transferring functions among facilities to consolidate wet processes and take advantage of scale economies in wastewater treatment.

c. Employment effects

Changes in employment due to the rule include both job losses that occur when facilities close and job gains associated with facilities' compliance activities. EPA estimated that a total of 5,916 jobs would be lost at the 199 facilities projected to close under the proposed rule. At the same time, EPA estimated that manufacturing and installing compliance equipment would lead to 4,488 full-time equivalent (FTE) positions, and that operating and maintaining compliance systems would result in another 286 FTEs per year. EPA projects a net loss in employment in the initial years following promulgation of the proposed rule, with net increased employment in later years due to the continuing compliance requirements. Net impacts on unemployment depend on how long workers displaced from closing facilities remain unemployed. Assuming conservatively that unemployed workers are out of work for one year on average, the proposed rule would result in a net gain of 2,575 years of employment (FTE-years) (−5,916 FTEs lost × 1 year + 4,488 one-time compliance FTEs + 296 continuing compliance FTEs × 15 years), or an average of 172 FTEs per year over 15 years. This estimate of employment impacts is likely to understate the net increase, because it ignores the fact that some production and employment lost at closing plants is likely to result in increased production and employment at other MP&M facilities.

d. Community impacts

EPA also considered the potential impacts of changes in employment due to the proposed rule on the communities where MP&M facilities are located. Given the projected overall increase in employment due to the proposed rule, EPA does not expect the rule to have significant impacts at the community level.

e. Foreign trade impacts

Facility closures caused by the proposed rule may reduce U.S. production of MP&M goods and services. EPA assessed the potential impact of these production changes on the U.S. balance of trade using information provided by the MP&M surveys on the source of competition in domestic and foreign markets. The analysis allocates the value of changes in output for each facility that is projected to close due to the rule to exports, imports or domestic sales, based on the predominant source of competition in each market reported in the surveys.

Table ES.9 shows the results of this analysis. The table compares the projected changes in exports, imports and balance of trade (expressed in $1999) to baseline 1999 values for both the MP&M industries and for the U.S. balance of trade in commodities as a whole. The projected changes in trade under the proposed rule have a very small impact on the balance of trade. The total U.S. balance of trade in commodities would decline by less than 0.01 percent and the balance of trade in the MP&M industries would decline by 0.01 percent.

Table ES.9: Potential Impacts of Proposed Rule on U.S. Foreign Commodity Trade (millions of 1999 dollars)

	1999 Exports [a]	1999 Imports	Trade Balance
Baseline	$695,797	$1,024,618	($328,821)
Change due to the rule	0	$21.1	($21.1)
Post-compliance	$695,797	$1,024,235	($328,438)
% Change from baseline	0%	<0.01%	(<0.01%)

a. Only 3 regulatory closures reported exports, totaling $16,613. These facilities reported no foreign competition in the international market.
Source: Bureau of Census and U.S. EPA analysis.

e. Impacts on new facilities

EPA assessed the impacts of the proposed rule on new facilities based on the characteristics of a model facility in each subcategory and (in some cases) discharge category

(direct and indirect). Engineering estimates of compliance costs for Option 2/6/10 and Option 4/8 for a representative facility reflect the typical flow size and other technical characteristics of facilities in each category. In the absence of the MP&M rule, new sources in the Metal Finishing Job Shop and Printed Wiring Board subcategories would comply with 40 CFR 433 new source requirements, and Steel Forming & Finishing new sources would comply with 40 CFR 420 new source requirements. Therefore, the analysis considers only the incremental costs of proposed MP&M new source requirements beyond those baseline requirements.

Table ES.10 shows the results of the new source analysis. New sources in all but the Metal Finishing Job Shop direct discharger subcategory incur costs that are below one percent of post-regulation revenues. Cost increases of this magnitude are unlikely to place new facilities at a competitive disadvantage relative to existing sources. Moreover, costs as a percentage of revenues are generally comparable for new sources and existing sources with which they will compete.

Table ES.10: Impacts on New Sources

Subcategory	Discharge Status	Proposed Technology Option	Annualized Compliance Costs (ACC) ($1999)	Facility Revenue ($1999)	New Source ACC as % of Revenue
General Metals	I	4	$393,220	$417,071,318	0.09%
General Metals	D	4	$167,342	$398,818,659	0.04%
Metal Finishing Job Shops	I	4	$65,369	$1,428,443	4.58%
Metal Finishing Job Shops	D	4	$70,735	$5,089,823	1.39%
Non-Chromium Anodizing*	D	2	$97,108	$24,201,166	0.40%
Oily Waste	I	6	$355,874	$474,228,616	0.08%
Oily Waste	D	6	$37,815	$116,772,943	0.03%
Printed Wiring Board	I	4	$70,563	$35,030,097	0.20%
Printed Wiring Board	D	4	$160,184	$1,029,783,596	0.02%
Railroad Line Maintenance*	D	10	$184,261	N/A	N/A
Shipbuilding Dry Dock*	D	10	$220,492	$192,018,827	0.11%
Steel Forming & Finishing	I	4	$114,851	$69,640,244	0.16%
Steel Forming & Finishing	D	4	$46,945	$32,759,295	0.14%

* EPA is not proposing Pretreatment Standards for New Sources in these subcategories.
Source: U.S. EPA analysis.

Railroad line maintenance facilities do not have revenue reported at the facility level, and it is therefore not possible to compare costs as a percent of facility revenue for new and existing facilities in this subcategory. The representative new source railroad line maintenance facility would incur annualized costs ($184,261) that are somewhat higher than those incurred by existing facilities in this subcategory (which range from zero to $122,042.)

f. Impacts on small entities

Table ES.11 shows the total number of facilities operating in the baseline and the number owned by small entities. Overall, approximately 80 percent of all MP&M facilities are owned by small entities. However, it should be noted that the low flow exclusions in the proposed rule will exclude approximately 85 percent of the facilities owned by small entities.

Table ES.11: Number and Percent of MP&M Facilities Owned by Small Entities

Type of Facility	Number of Facilities of all Sizes Operating in the Baseline	Number of Facilities Owned by Small Entities	Percent of Facilities Owned by Small Entities
Private MP&M[a]	54,591	44,773	82%
Government-Owned	4,332	2,672	62%
Total[a]	58,923	47,445	81%

a. Excludes baseline closures
Source: U.S. EPA analysis.

EPA assessed impacts on small entities by comparing compliance costs to revenues for the small entities at the firm level and by analyzing the facility impact analysis results for facilities owned by small firms. These analyses indicate that 941, or 2.2% of small entities may incur costs equal to 3 percent or more of annual revenues.

Approximately 85 percent of small entities are not projected to incur any costs to comply with the proposed rule because they are among the facilities covered by the low flow exclusions. More than 95 percent of small entities incur either no costs or compliance costs less than 1 percent of annual revenues. An estimated 181 facilities owned by small entities might close as a result of the proposed rule, and 492 facilities owned by small entities are likely to experience moderate financial impacts. The181 small entity facility closures represent less than one-half of one percent of the facilities owned by small entities that are operating in the baseline.

Tables ES.12 and ES.13 present the results of the firm- and facility-level analyses, respectively, for small firms. The Agency was not able to estimate national numbers of firms that own MP&M facilities precisely, because the sample weights based on the survey design represent numbers of facilities rather than firms. The results in Table ES.12 are reasonable approximations, however, in that 95 percent of the facilities owned by small firms are single-facility firms, for which sample weights could be used.

Table ES.12: Firm Level Before-Tax Annual Compliance Costs as a Percent of Annual Revenues for Private Small Businesses

Number of Small Firms in the Analysis*	Number and Percent with Before-Tax Annual Compliance Costs/Annual Revenues Equal to:					
	Less than 1%		1-3%		Over 3%	
	Number	%	Number	%	Number	%
42,509	40,560	95.4%	1,008	2.4%	941	2.2%

*Firms whose only MP&M facilities close in the baseline are excluded.
Source: U.S. EPA analysis.

Table ES.13: Closures and Moderate Impacts for Facilities Owned by Small Entities, Proposed Rule	
Number of facilities operating in the baseline	47,445
Number of facilities excluded	40,825
Percent excluded	85%
Number of closures	181
Percent closing	0.4%
Number of facilities with moderate impacts	492
Percent with moderate impacts	1.0%

Source: U.S. EPA analysis

EPA estimates that there are 2,672 facilities owned by small governments (those with populations less than 50,000). The low flow exclusion in today's proposed rule will exclude 2,262 of these small government-owned MP&M facilities. Thus, the proposed rule covers 410 small government-owned facilities. Of these facilities, only 270 incur costs, and the average cost per facility is less than $10,000. The total compliance cost for all the small government-owned facilities incurring costs under today's proposed rule is $2.7 million. Only 140 of the 270 facilities have costs greater than 1 percent of baseline cost of service (measured as total facility costs and expenditures, including operating, overhead and debt service costs and expenses). EPA estimated no significant impacts for any of these facilities, based on the combined impacts on the site cost of service, impacts on taxpayers, and impact on government debt levels.

ES.3.2 Social Costs

The social costs of the proposed rule represent the value of society's resources used to comply with and administer the rule. EPA estimated three categories of social cost for the proposed regulation:

- the cost of society's economic resources used to comply with the proposed regulation,
- the cost to governments of administering the proposed regulation, and
- the social costs of unemployment resulting from the regulation.

Summing across the categories of social cost results in a total social cost estimate of $2,033 to $2,113 million annually (1999$) (see Table ES.14). The social costs of the rule are dominated by the resource costs of compliance, which account for 95 to over 99 percent of total social costs. The midpoint value of total social costs (the simple average of the high and low values) is $2,073.3 million (1999$).

Table ES.14: Total Social Cost: Proposed Rule (million 1999$)		
Social Cost Categories	**Low Value**	**High Value**
Resource cost of compliance expenditures	$2,033.7	
Costs to POTWs of administering the rule	$0.115	$0.912
Social costs of unemployment	$0.0	$77.9
Total Social Cost	$2,033.9	$2,112.6

Source: U.S. EPA analysis

a. Resource costs of compliance

Resource costs of compliance are the value of society's productive resources — including labor, equipment, and materials — expended to achieve the reductions in effluent discharges required by the proposed rule. The social costs of these resources are higher than the costs incurred by facilities because facilities are able to deduct the costs from their taxable income. The costs to society, however, are the full value of the resources used, whether they are paid for by the regulated facilities or by all taxpayers in the form of lost tax revenues.

EPA did not include any costs for facilities that were predicted to close in the baseline, but did include costs for facilities that were projected to close due to the proposed rule, equal to the compliance cost they would incur if they continued to operate. This represents the value to society of the resources that would be used to comply with the proposed rule if all facilities continued to operate rather than some closing due to the rule. This estimate represents an upper-bound social value of the compliance resources associated with the proposed rule. The total social costs of these compliance resources is $2,034 million per year.

b. Administrative costs

The main component of this cost category is the cost of resources used to write permits under the proposed rule, and for compliance monitoring and enforcement activities. POTWs will incur costs to permit additional facilities, convert some permits from concentration-based to mass-based, and repermit some facilities earlier than would otherwise be required. While EPA expects that the proposed rule will also result in cost savings to permit writers, EPA did not include any such savings in the estimate of social costs.

EPA estimated the low and high estimates of permitting cost per facility, and took account of the need to repermit indirect dischargers with existing permits within the three year compliance period rather than on the normal five year permitting schedule. Total estimated government administration costs for the proposed rule range from $0.1 to $0.9 million (1999$) annually.

c. Social cost of unemployment

EPA considered two components of the social cost of unemployment that may result from the proposed rule:

- The cost of worker dislocation (exclusive of cash benefits) to unemployed individuals, as measured by their willingness to pay to avoid unemployment; and
- The additional cost to governments to administer unemployment benefits programs.

An estimated 5,916 jobs may be lost at facilities that close due to the proposed rule. EPA estimates that the annualized social costs associated with these job losses range from $59.1 million to $77.9 million (1999$). This estimate includes:

- $59.0 to $77.8 million (1999$) in the social cost of involuntary unemployment, based on high and low estimates of workers willingness to pay to avoid an episode of unemployment; and
- $0.1 million (1999$) in the cost to governments of administering additional unemployment claims.

The rule will also result in increased employment due to the need to manufacture, install, operate and maintain compliance equipment. The additional demand for labor in complying facilities may exceed the job losses estimated to occur in closing facilities. As a result, the net costs associated with unemployment as a result of the regulation may be negative. In this analysis, EPA used a range of zero to $77.9 million (1999$) as the estimated social cost of unemployment cost resulting from the proposed rule. To be conservative in the analysis, EPA limited the lower value of this range to zero. That is, EPA did not include the possible savings in unemployment-related costs as a negative cost (a benefit) of the proposed rule.

ES.4 Benefits of the Proposed Rule

The proposed regulation will reduce MP&M industry pollutant discharges with a number of consequent benefits to society, including:

- improved quality of freshwater, estuarine, and marine ecosystems;
- increased survivability and diversity of aquatic and terrestrial wildlife;
- reduced risks to human health through consumption of fish or water taken from affected waterways; and
- reduced cost of disposal or use of municipal sewage sludge affected by MP&M pollutant discharges.

EPA estimates that the proposed rule would substantially reduce pollutant discharges to U.S. waters, as shown by the loadings estimates in Table ES.14. Loadings are shown both in pounds of pollutant and in toxic-weighted pound equivalents. The latter measure reflects the relative toxicity of the various toxic pollutants. The regulation would result in a 89 percent reduction in total toxic-weighted pollutant lbs. equivalent per year. The estimated toxic weighted pollutant reductions range from 99% for cyanide to 30% for nonconventional organics. Reductions in pounds of

pollutants (not toxic-weighted) range from 99% for cyanide to 51% for priority organics. The proposed rule achieves very significant reductions for toxic metals, cyanide and conventional pollutants (oil and grease, total suspended solids, and chemical oxygen demand).

Table ES.14: Summary of Discharges by Pollutant Type for Potentially-Regulated MP&M Facilities[a]

Pollutant Category	Current Releases		Releases under The Proposed Rule		Percent Reduction due to the Proposed Rule	
	Pounds	Pounds Eq.	Pounds	Pounds Eq.	Pounds	Pounds Eq.
Priority Pollutants						
Metals	34,527,668	16,476,843	2,018,185	1,500,230	94%	91%
Organics	2,095,832	323,410	1,024,636	156,560	51%	52%
Cyanide (CN)	4,718,247	5,190,072	35,881	39,469	99%	99%
Nonconventional Pollutants						
Metals	120,756,930	7,201,034	23,723,669	1,265,904	80%	82%
Organics	50,468,179	210,501	9,411,727	146,873	81%	30%
Conventional Pollutants						
COD	2,445,579,193		601,888,710		75%	
O&G	220,782,391		20,953,718		91%	
TSS	231,466,565		27,404,519		88%	
Total		29,401,860		3,109,036		89%

[a] Includes all water-discharging facilities that continue to operate in the baseline, including facilities that are not subject to requirements under the proposed rule. Discharges discussed in this table are facility discharges and do not account for POTW removals. EPA believes it is appropriate to analyze wastewater discharges disregarding the POTW removals because indirect discharges present environmental risks that are not fully addressed by POTW treatment. The MP&M industry releases 89 pollutants that cause inhibition problems at POTWs and an additional 35 hazardous air pollutants (HAPs) that may present a threat to human health or the environment. Other MP&M pollutants released by the industry are found in POTW sludge. Only eight of these pollutants have land application pollutant criteria that limit the uses of sludge.
Source: U.S. EPA analysis.

EPA assessed the benefits from the expected pollutant loading reductions in three broad classes: human health, ecological, and economic productivity benefits. EPA was able to assess benefits within these three classes with varying degrees of completeness and rigor. Where possible, EPA quantified the expected effects and estimated monetary values. Some benefit categories could not be monetized due to data limitations and a limited understanding of how society values certain water quality changes. EPA also conducted a more detailed case study of the regulation's expected benefits for the State of Ohio. The case study addresses some of the limitations inherent in the national analysis.

The national benefits estimates for the proposed rule presented in this report range from $1.3 billion to $3.8 billion per year. In contrast, the preamble to the proposed rule presents benefits estimates ranging from $0.4 billion to $1.1 billion. The estimates in the preamble include human health benefits (reductions in cancer and lead exposure), recreational fishing benefits, non-use benefits, and improved POTW sludge quality. This report includes monetized estimates for additional benefits categories, specifically recreational boating and near-water recreation, and higher estimates for non-use benefits based on these additional recreational benefits.

EPA traditionally estimates national benefits and costs from proposed effluent limitations guidelines by extrapolating the benefits and costs assessment results for the sample facilities to the entire population of facilities nationwide. The analysis assumes that facilities represented by the sample

facility have the same technical, economic/financial and benefit characteristics, including:

Technical characteristics that affect costs and discharges:

- type of discharger (i.e., zero, direct, indirect);
- type and number of processes;
- number and types of metals;
- wastewater characteristics;
- treatment in place;
- flow size; and
- costs.

Economic and financial characteristics that affect financial impacts:

- markets, including domestic and foreign sales;
- competition, including domestic competition and imports;
- baseline financial position;
- cash flow;
- ability to borrow money; and
- liquidation values and closure costs.

Environmental and geographic characteristics that affect benefits:

- size of the receiving POTW,
- waterbody type,
- stream flow characteristics,
- populations residing near the waterbody, and
- the number of potential recreational users affected.

Extrapolation from the sample facilities to the entire population of facilities uses sample facility weights developed as part of the sampling plan. The sample weights are based on the stratification of the facility population using variables such as facility size and SIC code or industry sector. Sometimes stratification is done on the two previously mentioned variables alone, while other times EPA uses a database with considerably more information for stratification. Stratification generally does not include variables related to non-facility characteristics that may influence occurrence and magnitude of the expected benefits due to paucity of the relevant data concerning these variables at the time of sample plan design.

Not accounting for distribution of non-facility characteristics in the sample frame may occasionally cause extrapolation anomalies in benefits analyses and lead to a larger than desired level of uncertainty. Despite this extrapolation procedure shortfall, the resulting national estimates are unbiased (i.e., they are not expected to consistently overestimate or underestimate the parameters estimated).

Because EPA has not yet resolved some possible anomalies in the extrapolation of this analysis to the national level, the monetized benefits for the new categories of benefits are not included in the summary of benefits for the proposed rule that appears in the preamble. They are included in this report, however, to present the methodologies and their results as applied to the MP&M rule for public comment, concurrent with seeking peer review of these methodologies. Based on the results obtained using only sample facility locations and the case study results, EPA believes that the benefits of the MP&M regulation exceed the costs. EPA is not equally certain of the absolute level of benefits. The Agency is currently working on post-stratification of the MP&M facility sample to address this issue, and expects to have the process completed prior to the final regulation.

ES.4.1 Reduced Human Health Risk

EPA analyzed the following measures of health-related benefits: reduced cancer risk from fish and water consumption; reduced risk of non-cancer toxic effects from fish and water consumption; lead-related health effects to children and adults; and reduced occurrence of in-waterway pollutant concentrations in excess of levels of concern. The levels of concern include human health-based ambient water quality criteria (AWQC) or documented toxic effect levels for those chemicals not covered by water quality criteria. Although some health effects are relatively well understood and can be quantified and monetized in a benefits analysis (e.g., cancer), others are less well understood, and may not be assessed with the same rigor or at all (e.g., systemic health effects). The Agency therefore monetized only two of these health benefits: (1) changes in the incidence of cancer from fish and water consumption, and (2) changes in adverse health effects in children and adults from reduced lead exposure.

a. Benefits from reduced incidence of cancer cases

EPA estimated aggregate cancer risk from contaminated drinking water for populations served by drinking water intakes on waterbodies to which MP&M facilities discharge. This analysis is based on seven carcinogenic pollutants for which no published drinking water criteria are currently available. This analysis excludes six carcinogens for which drinking water criteria are available. EPA assumed that public drinking water treatment systems will remove these pollutants from the public water supply.

Calculated in-stream concentrations serve as a basis for estimating changes in cancer risk for populations served by affected drinking water intakes. EPA estimates that the proposed regulation would eliminate 2.24 cancer cases associated with consumption of contaminated drinking water, or 44 percent of the cancer cases associated with baseline MP&M discharges, annually.

EPA valued the reduced cancer cases using estimated willingness-to-pay (WTP) values for avoiding premature mortality. EPA estimates the mean value of avoiding one statistical death to be $5.8 million (1997$), based on cancer's association with both mortality and the hardships (e.g., psychic and other costs) from a prolonged period of morbidity prior to death. The Agency assumed that an individual would be willing to pay to avoid the disease at its start. This action may significantly precede the cancer-related death itself, if death occurs. The estimated monetary value of benefits from reduced incidence of cancer associated with drinking water is $17.7 million per year (1997$), based on the above assumptions.

EPA also estimated the aggregate cancer risk to recreational and subsistence anglers and their families from consuming contaminated fish. This analysis is based on thirteen carcinogenic pollutants found in MP&M effluent discharges. Estimated contaminants in fish tissue reflect predicted in-stream pollutant concentrations and biological uptake factors. EPA used data on numbers of licensed anglers by State and county, presence of fish consumption advisories, fishing activity rates, and average household size to estimate the affected population of recreational and subsistence anglers and their families. The analysis uses different fish consumption rates for recreational and subsistence anglers to estimate the change in cancer risk within these populations.

The proposed rule eliminates an estimated 0.05 cancer cases per year for combined recreational and subsistence angler populations, representing a reduction of about 36 percent from a baseline of about 0.13cases. This change translates into $0.36 million (1997$) in annual benefits due to reduced cancer risk from consumption of contaminated fish by these populations.

Total benefits from reduced incidence of cancer cases, including both drinking water and fish exposures, are $18.08 million (1997$) annually (see Table ES.15).

Table ES.15: Estimated Annual Benefits from Avoided Cancer Cases from Fish and Drinking Water Consumption

	Drinking Water		Fish Consumption		Total	
Regulatory Status	Annual Cancer Cases	Benefit Value (million 1999$)	Annual Cancer Cases	Benefit Value (million 1999$)	Annual Cancer Cases	Benefit Value (million 1997$)
Baseline	5.10	N/A[1]	0.126	N/A	5.23	N/A
Proposed Option	2.86	$17.70	0.081	$0.36	2.94	$18.08
Percent Reduction	43.9%	N/A	35.7%	N/A	43.9%	N/A

[1] Not Applicable

Source: U.S. Environmental Protection Agency

b. Reductions in systemic health effects

EPA estimates that the proposed rule would result in the removal of 142 million pounds of 77 pollutants related to a wide range of non-cancer human health effects (e.g., systemic effects, reproductive toxicity, and developmental toxicity). Reducing human exposure to these pollutants via fish and water consumption, relative to pollutant-specific health effects thresholds, yields an additional measure of the human health benefits likely to result from the proposed regulation. EPA compared estimated in-stream pollutant concentrations for 77 systemic toxicants with risk reference doses to calculate the hazard score distributions for populations consuming drinking water and fish. The Agency's comparison of baseline and post-compliance exposures shows population movement from higher to lower risk values for both the fish and drinking water analyses. Both analyses also show substantial increases in the percentage of the exposed populations that would not be exposed to any risk of systemic health hazards.

c. Benefits from reduced exposure to lead

EPA performed a separate analysis of benefits from reduced exposure to lead from consumption of contaminated fish tissue. The analysis addressed three population groups:

- preschool age children,
- pregnant women, and
- adult men and women.

Unlike the analysis of systemic health risk from exposure to other MP&M pollutants, this analysis is based on dose-response functions tied to specific health endpoints to which monetary values can be applied. Using blood-lead levels as a biomarker of lead exposure, EPA estimated baseline and post-compliance blood lead levels in the exposed populations and then used changes in these levels to estimate benefits in the form of avoided health damages.

EPA assessed neurobehavioral effects on children based on a dose-response relationship for IQ decrements. The Agency expressed avoided neurological and cognitive damages as changes in overall IQ levels, including reduced incidence of extremely low IQ scores (<70, or two standard deviations below the mean) and reduced incidence of blood-lead levels above 20 mg/dL. The analysis valued the avoided neurological and cognitive damages by using:

- the value of compensatory education that an individual would otherwise need, and
- the impact of an additional IQ point on individuals' future earnings.

EPA estimated that implementing the proposed rule would result in avoided IQ loss of 489 points across all exposed children. The estimated monetary value of avoided IQ loss is $4.9 million (1999$). In addition, reduced occurrences of extremely low IQ scores (<70) and reduced incidence of blood-lead levels above 20 mg/dL would result in a $0.1 million (1999$) decrease in the annual cost of compensatory education for children with learning disabilities.

Prenatal exposure to lead is an important exposure route. Fetal exposure to lead in utero due to maternal blood-lead levels may result in several adverse health effects, including decreased gestational age, reduced birth weight, late fetal death, neurobehavioral deficits in infants, and increased infant mortality. EPA assessed benefits to pregnant women by relating changes in the risk of infant mortality to changes in maternal blood-lead levels during pregnancy. This analysis estimated the monetary benefit of reduced neonatal mortality risk to be $12.7 million (1997$), based on the estimated WTP to avoid a mortality.

Adults also suffer form adverse health effects due to lead exposure. The adult health effects that EPA was able to quantify all relate to lead's effects on blood pressure. Quantified health effects include increased incidence of hypertension (estimated for males only), initial coronary heart disease (CHD), strokes (initial cerebrovascular accidents (CBA) and atherothrombotic brain infarctions (BI)), and premature mortality. This analysis does not include other health effects associated with elevated blood pressure, or other adult health effects of lead (e.g., nervous system disorders in adults, anemia, and possible cancer effects). EPA used cost of illness estimates (i.e., medical costs and lost work time) to estimate the monetary value of reduced incidence of hypertension, initial CHD, and strokes. EPA then used the value of a statistical life saved to estimate changes in the risk of premature mortality. The estimated monetary value of health benefits to adults is $18.0 million (see Table ES.16).

Total benefits from reduced exposure to lead, including both children and adults, are $35.8 million (1999$) annually under the proposed option.

Table ES.16: National Adult Lead Benefits (Millions of 1999$ per Year)

	Proposed Option	
Category	**Reduced Cases**	**Monetary Value**
Men		
Hypertension	959.85	$1.00
CHD	1.24	$0.09
CBA	0.52	$0.14
BI	0.29	$0.08
Mortality[a]	1.7	$13.41
Women		
CHD	0.39	$0.03
CBA	0.17	$0.03
BI	0.10	$0.02
Mortality[a]	0.41	$3.24
Total Benefits		**$18.04**

a. Unlike other benefits in this table, the value of avoided mortality is expressed in 1997$.

National Level Exposed Population:

- Hypertension: 428,363 men ages 20 to 74;
- Coronary heart disease, cerebrovascular accidents, brain infarction, and mortality: 173,386 men and 192,091 women ages 45-74.

d. Exceedances of Human Health-Based AWQC

EPA also estimated the effect of MP&M facility discharges by comparing the estimated baseline and post-compliance in-

stream concentrations of 18 pollutants in affected waterways to human health AWQC through two consumption routes:

- water and organisms, and
- organisms alone.

Pollutant concentrations in excess of these values indicate potential human health risks.

❖ ***Consumption of water and organisms***

EPA estimates that 10,310 receiving reaches nationwide have baseline in-stream concentrations exceeding human health AWQC for consumption of water and organisms. The proposed rule eliminates these excess concentrations on 1,105 of those reaches.

Results also show that 382 receiving reaches will experience partial water quality improvements from reduced occurrence of some pollutant concentrations in excess of AWQC limits for consumption of water and organisms.

❖ ***Consumption of organisms alone***

EPA estimates that 192 receiving reaches nationwide have baseline in-stream concentrations exceeding human health AWQC for consumption of organisms alone. The proposed rule eliminates these excess concentrations on 121 of those reaches.

ES.4.2 Ecological, Recreational, and Nonuser Benefits

EPA expects the proposed regulation to provide ecological benefits by improving the habitats or ecosystems (aquatic and terrestrial) affected by MP&M discharges. Benefits associated with changes in aquatic life include:

- restoring sensitive species,
- recovering diseased species,
- reducing taste-and odor-producing algae populations,
- increasing dissolved oxygen (DO), and
- increasing the assimilative capacity of affected waterways.

These improvements enhance the quality and value of water-based recreation, such as fishing, swimming, wildlife viewing, camping, waterfowl hunting, and boating. The benefits from improved water-based recreation include the increased value that participants derive from a day of recreation, or the increased number of days that consumers of water-based recreation choose to visit the cleaner waterways. This analysis measures the economic benefit to society based on the increased monetary value of recreational opportunities resulting from water quality improvements.

a. Reduced aquatic life impacts

EPA estimated the cases in which in-waterway pollutant concentrations resulting from baseline MP&M facility discharges on affected waterways exceed recommended acute and chronic AWQC protecting aquatic life. Pollutant concentrations in excess of these AWQC values indicate potential impacts to aquatic life.

The analysis compared baseline and post-compliance exceedances of aquatic life AWQC to determine the effects of the rule. Results show that baseline pollutant concentrations exceed acute AWQC in 878 reaches and chronic AWQC in 2,466 reaches nationally at baseline discharge levels. EPA estimates that the proposed option eliminates concentrations in excess of acute and chronic criteria in 775 and 1,029 reaches, respectively. Results also show that an additional 903 receiving reaches will experience partial water quality improvements from reduced occurrence of some pollutant concentrations in excess of acute and/or chronic AWQC limits for protection of aquatic life.

b. Recreational benefits

EPA assessed the recreational benefits from reduced occurrence of pollutant concentrations exceeding aquatic life and/or human health AWQC values. Combining its findings from both the aquatic life and human health AWQC exceedance analyses, EPA found 10,443 stream reaches exceeding chronic or acute aquatic life AWQC and/or human health AWQC values at baseline discharge levels. The Agency estimates that the proposed rule will eliminate exceedances on 1,185 of these discharge reaches, leaving 9,258 reaches with concentrations of one or more pollutants exceeding AWQC limits. Of these 9,258 reaches, 1,837 reaches will experience partial water quality improvements from reduced occurrence of some pollutant concentrations in excess of AWQC limits.

EPA attached a monetary value to reduced exceedances based on increased values for three water-based recreation activities (fishing, wildlife viewing, and boating) and on nonuser values. EPA applied a benefits transfer approach to estimate the total WTP, including both use and nonuse values, for improvements in surface water quality. This approach builds upon a review and analysis of the surface water valuation literature.

EPA first estimated the baseline value of water-based recreation for benefiting reaches, based on per-reach estimates of:

- annual person-days of water-based recreation, and
- per-day values of water-based recreation.

EPA based baseline per-day values of water-based recreation on studies by Walsh et. al (1992) and Bergstrom and Cordell (1991). The studies provide values per recreation day for a wide range of water-based activities, including fishing, boating, wildlife viewing, waterfowl hunting, camping, and picnicking. The mean values per recreation day used in this analysis are $39.62, $24.72, and $45.44 (1999$) for fishing, near-water recreation, and boating, respectively.

EPA then applied the percentage change in the recreational value of water resources implied by surface water valuation studies to estimate changes in values for all MP&M reaches in which the regulation eliminates AWQC exceedences by one or more MP&M pollutants. The Agency selected eight of the most comparable studies and calculated the changes in recreation values from water quality improvements (as a percentage of the baseline) implied by those studies. Sources of estimates included Lyke (1993), Jakus et al. (1997), Montgomery and Needleman (1997), Paneuf et al. (1998), Desvousges et al. (1987), Lant and Roberts (1990), Farber and Griner (2000), and Tudor et al. (2000). EPA took a simple mean of point estimates from all applicable studies to derive a central tendency value for percentage changes in the water resource values due to water quality improvements. These studies yielded estimates of increased recreational value from water quality improvements expected from reduced MP&M discharges of 12.7, 20.2, and 12.4 percent for fishing, wildlife viewing, and boating, respectively. Table ES.17 provides the estimated national recreational benefits of the proposed rule (1999$).

EPA also estimated non-market nonuser benefits. These benefits are not associated with current use of the affected ecosystem or habitat; instead, they arise from the value that society places on improved water quality independent of planned uses or based on expected future use. Past studies have shown that nonuser values are a sizable component of the total economic value of water resources. EPA estimated average changes in nonuser value to equal one-half of the recreational use benefits. The estimated increase in nonuser value is $760.3 million (1999$).

Table ES.17: Estimated Recreational Benefits from Reduced MP&M Discharges (Proposed Option)

Recreational Activity	Low	Mid	High
Fishing	$196	$365	$627
Boating	$265	$446	$672
Wildlife Viewing and Near-Water Recreation	$500	$710	$920
Total Recreational Use Benefits (Fishing + Boating + Wildlife Viewing)	$961	$1,521	$2,219
Nonuser Benefits (1/4, ½, and 2/3 of Total Recreational Use)	$240	$760	$1,464
Total Recreational Benefits (million 1999$)	**$1,201**	**$2,281**	**$3,683**

Source: U.S. EPA analysis.

The recreational trips corresponding to the three activities considered in this analysis are stochastically independent; EPA calculated the total value of enhanced water-based recreation opportunities by summing the three recreation categories and nonuser value. The resulting increase in the value of water resources to consumers of water-based recreation and nonusers is 2,281 million (1999$) annually.

ES.4.3 Reduced POTW Impacts

EPA evaluated two productivity measures associated with MP&M pollutants. The first measure was the pollutant interference at publicly-owned treatment works (POTWs), which was quantified but not monetized. The second measure was the pass-through of pollutants into the sludge, which limits options for its disposal.

MP&M pollutants may impair POTW treatment effectiveness by inhibiting the biological activity of activated sludge. EPA estimated inhibition of POTW operations by comparing predicted POTW influent concentrations with available inhibition levels for 89 pollutants. POTW inhibition values come from guidance published by EPA and other sources. At baseline discharge levels, EPA estimates that concentrations of 18 pollutants discharged from MP&M facilities exceed biological inhibition criteria at 515 POTWs nationwide. The proposed regulation would eliminate potential inhibition problems at 306 POTWs and reduce the

occurrence of pollutant concentrations in excess of inhibition criteria at 82 POTWs. POTWs may impose local limits to prevent inhibitions. If local limits are in place, the estimated reduction in potential inhibition problems at the affected POTWs is overstated. In this case, however, the estimated social cost of the MP&M regulation is also overstated.

EPA also quantified the reduced costs for managing and disposing of sewage sludge. This analysis relied on data from 147 POTW surveys. POTWs provided information on sewage sludge use and disposal costs and practices, total metal loadings to the POTW, percentage of total metal loadings contributed by MP&M facilities, and the number of known MP&M dischargers to the POTW. The survey also provided information on the percentage of qualifying sludge that is not land applied, and reasons for not land applying qualifying sludge.

EPA estimated baseline and post-compliance sludge concentrations of eight metals for POTWs receiving discharges from the sample MP&M facilities. EPA compared these concentrations with the relevant metal concentration limits for land application and surface disposal. EPA estimated that concentrations of one or more metals at 6,953 POTWs would fail the land application limits in the baseline. EPA estimated that 62 POTWs will be able to select the lower-cost land application disposal based on estimated reductions in sludge contamination. An estimated 1.7 million dry metric tons (DMT) of sewage sludge would newly qualify for land application annually. EPA also estimated that 21 POTWs that previously met only the land application pollutant limit would, as a result of regulation, meet the more stringent land application concentration limits. EPA expects these POTWs to benefit through reduced recordkeeping requirements and exemption from certain sludge management practices. The annual estimated cost savings for the POTWs expected to upgrade their sludge disposal practices are $61.3 million (1999$).

This analysis includes an adjustment to the estimate of national sludge use/disposal cost benefits for POTWs located at cost-prohibitive distances from agricultural, forest, or disturbed lands suitable for sludge application. EPA assumed that 46 percent of sludge generated in the United States is generated by POTWs located too far from sites suitable for sewage sludge application to make these practices economical.

ES.4.4 Total Estimated Benefits of the Proposed MP&M Rule

EPA estimates that total benefits for the five categories for which monetary estimates were possible are $2.396 billion (1999$) annually. EPA characterized uncertainty inherent in the benefits analysis by bounding benefit estimates. The annual lower- and upper-bound benefit estimates of the proposed option are $1,284 and $3,833 billion (1999$), respectively. The monetized benefits of the rule underestimate its total benefits because they omit numerous sources of benefits to society from reduced MP&M effluent discharges. Examples of benefit categories not reflected in this estimate include: non-cancer health benefits other than benefits from reduced exposure to lead; other water-dependent recreational benefits, such as swimming and waterskiing; reduced cost of drinking water treatment for the pollutants with drinking water criteria; and benefits to wildlife and endangered species.

ES.5 Comparing Estimated Costs and Benefits

EPA cannot perform a complete cost-benefit comparison because not all of the benefits resulting from the proposed regulatory alternative can be valued in dollar terms. Table ES.18 shows that combining the estimates of social benefits and social costs yields an estimate of net monetizable benefits ranging from negative $809 million to positive $1,752 million annually (1999$) at the national level. Comparing the midpoint estimate of social costs with the midpoint estimate of monetized benefits results in a net benefit of $311 million. The lack of a comprehensive benefits valuation limits this assessment of the relationship between costs and benefits of the proposed rule.

Table ES.18: Comparison of National Annual Monetizable Benefits to Social Costs: Proposed Rule (millions of 1999$)

Benefit and Cost Categories	Low	Midpoint	High
Benefit Categories			
Reduced Cancer Risk from Fish Consumption[a]	$0.3	$0.3	$0.3
Reduced Cancer Risk from Water Consumption[a]	$13.0	$13.0	$13.0
Reduced Risk from Exposure to Lead	$28.0	$28.0	$28.0
Enhanced Water-Based Recreation	$960.6	$1,520.7	$2,218.7
Nonuse Benefits	$240.2	$760.3	$1,464.3
Avoided Sewage Sludge Disposal Costs	$61.1	$61.3	$61.5
Total Monetized Benefits	**$1,303.2**	**$2,383.6**	**$3,785.8**
Cost Categories			
Resource Costs of Compliance	$2,033.7	$2,033.7	$2,033.7
Costs of Administering the Proposed Regulation	$0.1	$0.3	$0.9
Social Costs of Unemployment	$0	$39.0	$78.0
Total Monetized Costs	$2,033.9	$2,073.0	$2,112.6
Net Monetized Benefits (Benefits Minus Costs)[b]	**($809.4)**	**$310.6**	**$1,751.9**

a. The monetary value of benefits from reduced incidence of cancer is based on 1997$.
b. EPA calculated the low net benefit value by subtracting the high value of costs from the low value of benefits, and calculated the high net benefit value by subtracting the low value of costs from the high value of benefits. The midpoint net benefit is based on the midpoint values for costs and benefits.
Source: U.S. EPA analysis.

As previously mentioned, extrapolating from sample facility results to national results can introduce uncertainty into the analysis for both the cost and the benefits estimates. EPA therefore also compared costs and benefits for the sample facilities alone, basing the sample results on known facility and benefit pathway characteristics. Table ES.19 presents the results of this analysis. EPA found that the relationship between benefits and costs for sample facilities alone (i.e., those facilities whose receiving stream characteristics are known) are similar to that found in the national analysis. Specifically, in both analyses the low estimate for net benefits is negative while the midpoint and high estimates for net benefits are positive. This similarity in the relationship between benefits and costs in the two analyses significantly increases EPA's confidence that the benefits of the regulation exceed the costs, even when the estimated total value of national benefits has some uncertainties associated with it.

Table ES.19: Comparison of Annual Monetizable Benefits to Social Costs for Sample Facilities: Proposed Rule (thousands of 1999$)

Benefit and Cost Categories	Low	Midpoint	High
Reduced Cancer Risk from Fish Consumption [a]	$17.4	$17.4	$17.4
Reduced Cancer Risk from Water Consumption [a]	$1,057.1	$1,057.1	$1,057.1
Reduced Risk from Exposure to Lead	$2,585.0	$2,585.0	$2,585.0
Enhanced Water-Based Recreation	$68,990.4	$108,803.9	$158,121.1
Nonuse Benefits	$17,247.6	$54,402.0	$104,359.9
Avoided Sewage Sludge Disposal Costs	$7,532.1	$7,532.4	$7,532.7
Total Monetized Benefits	**$97,429.6**	**$174,397.8**	**$273,673.2**
Total Monetized Costs [b]	**$121,392.9**	**$121,392.9**	**$121,392.9**
Net Monetized Benefits (Benefits Minus Costs) [c]	**($23,963.3)**	**$53,004.9**	**$152,280.3**

a. The monetary value of benefits from reduced incidence of cancer is based on 1997$.
b. Total monetized costs represent the resource cost of compliance only. This analysis does not include the cost of administering the proposed regulation and the social cost of unemployment. Excluding these costs does not affect the conclusions of their analysis because these costs are very small relative to the resource cost of compliance.
c. EPA calculated the low net benefit value by subtracting the high value of costs from the low value of benefits, and calculated the high net benefit value by subtracting the low value of costs from the high value of benefits. The middle net benefit is based on the midpoint values for costs and benefits.
Source: U.S. EPA analysis.

ES.6 Ohio Case Study

The Ohio case study assesses the costs and benefits of the proposed rule for the state's facilities and waterbodies. Ohio is among the ten states with the largest numbers of MP&M facilities. Ohio has a diverse water resource base and a more extensive water quality ecological database than many other states. EPA gathered data on MP&M facilities and on Ohio's baseline water quality conditions and water-based recreation activities to support the case study analysis. These data characterize current water quality conditions, water quality changes expected from the regulation, and the expected welfare changes from water quality improvements at waterbodies affected by MP&M discharges. The case study also estimates the social costs of the proposed rule for facilities in Ohio, and compares estimated social costs and benefits for the State.

The case study analysis supplements the national level analysis performed for the proposed MP&M regulation in two important ways:

- the analysis used improved data and methods to determine MP&M pollutant discharges from both MP&M facilities and other sources. In particular, EPA oversampled Ohio with 1,600 screener questionnaires to augment information on the State's MP&M facilities. The Agency also used information from the sampled MP&M facilities to estimate discharge characteristics of non-sampled MP&M facilities, as described in Appendix G of the EEBA.
- the analysis used an original travel cost (TC) study to value four recreational uses of water resources affected by the regulation: swimming, fishing, boating, and near-water activities.

The added detail provides a more complete and reliable analysis of water quality changes from reduced MP&M discharges. The study provides more complete estimates of changes in human welfare resulting from reduced health risk, enhanced recreational opportunities, and improved economic productivity.

The case study analysis of recreational benefits combines water quality modeling with a random utility model (RUM) to assess how changes in water quality from the regulation will affect consumers' valuation of water resources. The RUM analysis addresses a wide range of pollutant types and effects, including water quality measures not often addressed in past recreational benefits studies. In particular, the model supports a more complete analysis of recreational benefits from reductions in nutrients and toxic pollutants (i.e., priority pollutants and nonconventional pollutants with toxic effects).

ES.6.1 Benefits

The use of an original RUM model allows the Agency to address limitations inherent in benefits transfer used in the analysis of recreational benefits at the national level. The use of benefits transfer often requires additional assumptions because water quality changes evaluated in the

available recreation demand studies are only roughly comparable with the water quality measures evaluated for a particular rule.

The RUM model estimates the effects of the specific water quality characteristics analyzed for the proposed MP&M regulation, such as the presence of AWQC exceedances and concentrations of the nonconventional nutrient Total Kjeldahl Nitrogen (TKN). This direct link between the water quality characteristics analyzed for the rule and the characteristics valued in the RUM analysis reduces uncertainty in benefit estimates and makes the analysis of recreational benefits more robust.

In addition to conventional pollutants and TKN, the proposed MP&M regulation affects a broad range of pollutants, many of which are toxic to human and aquatic life but are not directly observable (i.e., priority and non-conventional pollutants). These unobservable toxic pollutants degrade aquatic habitats, decrease the size and abundance of fish and other aquatic species, increase fish deformities, and change watershed species composition. Changes in toxic pollutant concentrations may therefore affect recreationists' valuation of water resources, even if consumers are unaware of changes in ambient pollutant concentrations.

The study used data from the 1993 National Demand Survey for Water-Based Recreation (NDS), conducted by EPA and the National Forest Service, to examine the effects of in-stream pollutant concentrations on consumers' decisions to visit a particular waterbody. The analysis estimated baseline and post-compliance water quality at recreation sites actually visited by the surveyed consumers and at all other sites within the consumers' choice set, visited or not. The RUM analysis of consumer behavior then estimated the effect of ambient water quality and other site characteristics on the total number of trips taken for different water-based recreation activities and the allocation of these trips among particular recreational sites. The RUM analysis is a TC model, in which the cost to travel to a particular recreational site represents the "price" of a visit.

EPA modeled two consumer decisions:

- how many water-based recreational trips to take during the recreational season (the trip participation model), and
- which recreation site to choose (the site choice model).

Combining the trip participation model's prediction of trips under the baseline and post-compliance scenarios and the site choice model's per-trip welfare measure provides a measure of total welfare. EPA calculated each individual's seasonal welfare gain for each recreation activity from post-compliance water quality changes, and then used Census data to aggregate the estimated welfare change to the State level. The sum of estimated welfare changes over the four recreation activities yielded estimates of total welfare gain.

EPA estimated other components of benefits in Ohio using similar methodologies to those used for the national-level analysis. In addition to the RUM study of recreational benefits, other analytical improvements included use of the following:

- more detailed data on MP&M facilities, obtained from the 1,600 additional surveys;
- data on non-MP&M discharges to estimate current baseline conditions in the state; and
- a first-order decay model to estimate in-stream concentrations in the Ohio waterbodies in the baseline and post-compliance.

The Agency believes that the added level of detail results in more robust benefit estimates.

Summing the monetary values over all benefit categories yields total monetized benefits of $181.8 to $298.7 million (1999$) annually for the proposed option, as shown in Table ES.20. The midpoint estimate of monetized benefits for the proposed option is $244.0 million (1999$). Although more comprehensive than the national benefits analysis, the case study benefit estimates still omit some mechanisms by which society is likely to benefit from the proposed rule. Examples of benefit categories not reflected in the monetized benefits include non-lead related non-cancer health benefits and reduced costs of drinking water treatment.

Table ES.20: Annual Benefits from Reduced MP&M Discharges in Ohio: Proposed Option (1999$)

Benefit Category	Low	Midpoint	High
1. Reduced Cancer Risk[a]			
Fish Consumption	$57	$182	$313
Water Consumption	$77,401	$244,587	$421,062
2. Reduced Risk from Exposure to Lead:			
Children	$32,509	$63,856	$96,944
Adults	$25,982	$70,661	$117,822
3. Enhanced Water-Based Recreation	$145,365,723	$162,449,204	$179,532,685
4. Nonuse Benefits	$36,341,431	$81,224,602	$118,492,572
5. Avoided Sewage Sludge Disposal Costs	$10,000	$10,000	$10,000
Total Monetized Benefits	**$181,853,103**	**$244,126,948**	**$298,768,342**

a. The monetary value of benefits from reduced incidence of cancer is based on 1997$.
Source: U.S. EPA analysis.

ES.6.2 Social Costs

EPA also estimated the social costs of the proposed rule for MP&M facilities in Ohio. Predicting the number of regulatory closures is necessary to estimate the costs and impacts of the regulation on industry and water quality. Facilities that are baseline closures will not be affected by the proposed MP&M regulation.

The screener data collected for Ohio facilities did not provide financial data to perform an after-tax cash flow or net present value test, as done in the national analysis. EPA therefore used data from the national analysis to estimate the percentage of facilities that would close in the baseline and post-compliance. EPA assumed that the ratio of facilities that close in the national analysis would be comparable to that for Ohio facilities with the same discharge status, subcategory, and flow category. For example, eight percent of indirect General Metals facilities discharging more than 6.25 million gallons per year close in the baseline in the national data set; this same percent distribution is assumed for Ohio screener indirect dischargers in that flow size category.

EPA developed engineering estimates of compliance costs for each Ohio facility, and annualized costs using a seven percent discount rate over a 15-year period. As in the national social cost analysis, EPA included compliance costs for facilities that close due to the rule, as well as costs for facilities that continue to operate subject to the proposed regulation. Including costs for regulatory closures in effect calculates the social costs of compliance that would be incurred if every facility continued to operate post-regulation. In fact, some facilities find it more economic to close. For this reason, calculating costs as if all facilities continue operating provides an upper-bound estimate of social costs.

EPA used the same methods as used in the national social cost analysis to estimate other components of social costs for the Ohio case study. Table ES.21 shows the total estimated social costs of the proposed rule for Ohio facilities.

Table ES.21: Annual Social Costs for Ohio Facilities: Proposed Option (millions 1999$, costs annualized at 7%)

Component of Social Costs	Lower bound	Midpoint	Upper bound
Resource value of compliance costs		$141.7	
Government administrative costs	$0.011	$0.025	$0.083
Social cost of unemployment	$.007	$3.673	$7.338
Total Social Cost	$141.7	$145.4	$149.1

ES.6.3 Comparing Monetized Benefits and Costs

The social cost of the proposed rule in Ohio is estimated at $141.7 to $149.1 million annually (1999$). The sum total of benefits that can be valued in dollar terms ranges from $181.8 million to $298.7 million annually (1999$). Combining the estimates of social benefits and social costs yields a net monetizable benefit ranging from $32.7 million to $157.0 million annually. Comparing the midpoint estimate of social costs ($145.4 million) with the midpoint estimate of monetizable benefits ($244.1 million) results in a net social benefit of $98.7 million. This represents a partial cost-benefit comparison because not all of the benefits resulting from the proposed rule can be valued in dollar terms. The Ohio case study shows substantial net positive benefits even for the lower-bound estimate of benefits.

The Ohio case study is more robust than most analyses that EPA usually performs for the following reasons:

- the study provides more detailed data on MP&M facilities than is possible at the national level;
- better water quality data were available for this state than is usually available;
- the 1600 Screeners provided information on locations of MP&M facilities in Ohio allowing the Agency to take more accurate account of joint discharges to the same reach;
- it includes data on non-MP&M discharges in the baseline and post compliance;
- it includes the affect of MP&M discharges of nutrients such as TKN;
- it uses a first-order decay model to estimate in-stream concentrations in downstream waterbodies; and
- it includes an additional recreational benefit category (swimming) in the analysis.

In addition, the RUM model used to estimate recreational benefits allows EPA to estimate the effects of specific water quality characteristics analyzed for the proposed MP&M regulation, (i.e., the presence of AWQC exceedances.) This direct link between the water quality characteristics analyzed for the rule and the characteristics valued in the RUM analysis reduces uncertainty in benefit estimates and makes the analysis of recreational benefits more robust.